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Management Considerations for Continuous Corn Production

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Management considerations for continuous corn production

Symposium moderator: Lori Abendroth, Agronomy Specialist, Agronomy, Iowa State University

Production considerations

Roger Elmore, Professor, Agronomy, Iowa State University

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Growing a corn crop after a previous crop of corn on the same ground requires special management. But we've done it before! In 1976, Iowa had around 14 million acres of corn and 6 ½ million acres of soybean. That is about a 2:1 ratio. The ratio of corn to soybean in 2006 was 55:45 with nearly 13 million acres of corn.

We can grow more corn. The question is how to do it without sacrificing yield. Although in some of the better years for growing corn and in some environments in those years yields are similar for corn following corn and corn following soybeans, we don't yet know how to duplicate this. In other words we know of no magic bullet or recipe that will allow us to repeatedly obtain similar yields in both systems. Certainly, understanding tillage, fertility, and equipment issues help us understand some of the limitations and potentials. Other speakers in this session address those areas. Here is a checklist of some other things to think about:

Select hybrids with

- Superior seedling vigor
- Disease tolerance
- Stalk and root health
- Insect resistance (Bt/RW) and/or insecticides
- Overall stress-tolerant hybrids

Optimizing Planting date

- It will take longer to plant corn. Avoid planting excessively early to minimize the impact of cold soil temperatures on stand establishment and seedling vigor.
- More corn will be planted outside of the optimum planting window.
- Be aware of increased risk of soil insects and diseases affecting seeds and seedlings.

Potential issues for weed management:

- Volunteer
- Weed resistance
- Increased residue can decrease herbicide efficacy of some soil applied herbicides.
- Some weed species thrive in tillage systems that leave more surface residue.
- Include pre- and post-emergence herbicides for residual activity.
- Rotate herbicide modes of action.

Insect management

- Control Corn Rootworms
  - Soil-applied insecticides
  - Insecticide seed treatments
  - Transgenic Bt for rootworm
- Scout fields during emergence for wireworms, cutworms, seed corn maggots, etc.
- Control Western Bean Cutworm. Intensify scouting for egg masses and spray or use transgenics.
- What will happen to European Corn Borer with corn following corn?

Disease management:

- Select hybrids that have lower susceptibility or increased tolerance towards certain diseases
- Bury crop residues through tillage
- Use fungicides wisely to control disease outbreaks

Economics:

- Cost of production is greater compared to a corn-soybean rotation.
- Break-even corn prices…?
- More acres in a single crop = increased risk!
- Grain prices

Soil Fertility

John Sawyer, Associate Professor, Agronomy, Iowa State University

Nitrogen

- Use the web tool *Corn Nitrogen Rate Calculator* (http://extension.agron.iastate.edu/soilfertility/nrate.aspx) to determine suggested N fertilization rates for continuous corn based on different prices of N and corn grain (price ratios). For example, with $0.30/lb N and $3.00/bu (a common price ratio of 0.10 $/lb:$/bu), the suggested N application rate is within a 150 to 200 lb N/acre range, and the rate that provides the maximum economic return is approximately the midpoint of 175 lb N/acre.
  - These suggested rates can be used for continuous corn, and second or third year corn after soybean.
  - The suggested rates do not vary by yield level or yield goal.
  - The suggested rates can be used for determining fertilizer and manure applications.
  - The suggested rates are for the total N to be applied. Therefore the primary N product rate should have starter, weed-and-feed, and DAP/MAP N applications subtracted.
- Apply fertilizer products and manure at the appropriate time and placement to avoid losses and provide the greatest benefit from the application.

  - Consider spring preplant, sidedress, and split/sidedress N applications.
  - Apply fall ammonia after soils cool, 50°F and continued cooling (the colder the better).
  - Don't apply urea-ammonium nitrate solutions (28 or 32% UAN), ammonium sulfate, or ammonium nitrate in the fall.
  - Apply products containing nitrate close to planting or sidedress.
  - Incorporate or inject urea and UAN solutions.
  - Apply N split/sidedress on soils that are coarse-textured, underlain with fractured bedrock, have poor internal drainage, prone to excess wetness, or spring flooding.
  - Consider a nitrification inhibitor with fall-applied ammonia.
  - Consider a urease inhibitor with surface applied urea/UAN, especially with high surface residue cover.
- Ensure an adequate level of available N in the root zone for early corn growth by application of 20-30 lb N/acre applied preplant or as starter N, especially with planned primary N applied sidedress and with no-tillage production.
- Application of urea or UAN in the fall will not speed residue decomposition, and exposes the N to potential over-winter and spring losses.

Phosphorus and Potassium

- Routinely soil test to determine P and K fertilization needs.
- Don't apply unneeded fertilizer when soils test High and Very High.
- The Optimum soil test category is the most profitable to maintain, and suggested P and K rates for soils testing in that category are based on crop removal. High yields result in large P and K removal, especially if stover or silage is removed.
- Phosphorus and K fertilizers can be applied in the fall or spring. Incorporation can be with fall primary or spring tillage for seedbed preparation, and incorporated with primary or secondary tillage. For no-tillage, application is best done in the fall. Also, for no-tillage, and especially for ridge-tillage, banding K in the soil will increase K supply and provide additional yield response.
- Phosphorus and K can be applied every year or one application for multiple years.
- Manure is a good source of crop-available P and K. Watch the P and K application rates since the ratio of N, P, and K in manures may not match fertilization requirements. Soil testing will help confirm application amounts and future needs.

Soil pH and Liming

- Maintain soil pH at suggested levels, 6.0 to 6.5 as appropriate for Iowa soils. Corn is not as responsive to liming slightly acidic soils as is soybean.
- Application of required higher N rates, and every year application in continuous corn, will result in faster soil pH decline compared to corn in rotation with soybean. Therefore more frequent liming may be needed with continuous corn.

Tillage Challenges in Managing Continuous Corn

Mahdi Al-Kaisi, Associate Professor, Agronomy, Iowa State University

There are several challenges in managing continuous corn as far as tillage is concerned. Residue management, seed placement, N application, and equipment attachments are just to name a few. Residue presents management problems, particularly with conservation tillage and no-tillage used in continuous corn production. There will be a significant amount of residue buildup with continuous corn, which requires a different approach in terms of tillage system and equipment needs. The impact of tillage coupled with a mono cropping system will have significant impact on set of soil and water quality aspects in addition to potential yield decline.

Residue management and tillage system

Managing residue with continuous corn largely depends on what kind of tillage system will be used. The most challenging system will be NT with C-C. No-tillage systems have both advantages and challenges concerning the management of crop residue. One of the main advantages of this system is that it leaves significant amounts of crop residue on the soil surface, which protects the soil from water erosion and improves soil tilth. Conversely, these significant amounts of residue pose a challenge of their own: How to manage residue as a part of a no-till system. To ensure the success of no-till, farmers need to use a system approach in the management of residue. This involves the integration of planting, nutrient application, and harvesting processes. While each of these components is important, there are things to consider in managing crop residue in a no-till system:

1) Residue height after harvest: To have an effective and manageable residue cover at planting is to have corn residue cut as high as 12 to 24 inches. There are several reasons for that. (1) Cutting residue at that height minimizes the potential damage to equipment tires during planting and other field operations. (2) Standing residue will be much easier to manage during planting, where minimum loose residue on the soil surface can be managed with residue-removal attachments on the planter. (3) Upright residue can provide better protection to the soil surface from wind and water erosions by reducing wind and water flow near the surface. Given these reasons against chopping corn residue, no-till can be managed efficiently without affecting yield.
2) Residue amount and distribution of residue during harvest: While cutting residue after harvest is one technique for managing crop residue, it is possible to avoid this step all together. This can be accomplished by calibrating the combine properly to ensure a uniform residue distribution on the soil surface. A few adjustments and fine tuning of a combine prior to harvest can pay off significantly in having uniform residue cover across the field.
3) Fall N application for residue decomposition: Research showed that Fall N application did not consistently increase residue decomposition. Sometime, fall N application may have furnished N to stimulate residue decomposition in N deficient environments.

Residue Decomposition

Corn residue is classified as non-fragile, which will decompose much slower compared to soybean or other small grain residue. However, the benefits of slow residue decomposition are:

- Provide longer protection time for soil from water erosion.

- Provide a good coverage in conserving soil moisture.
- Upright corn residue can trap snow more effectively during the off season.
- Provide larger carbon input to soil compared to soybean residue.
- Removing or incorporating residue reduces its value in terms of C input and reduction of soil organic matter protection.
- Residue enhances wildlife habitat.

Tillage and Soil Quality

- Negative effect on soil carbon due to extensive tillage.
- Tillage can increase soil erosion and reduction of water quality.
- Decrease in aggregate stability and soil structure with extensive tillage.
- Tillage can reduce soil infiltration and increase surface runoff.
- Tillage can increase soil compaction and limit root development.

Soil Temperature and Residue Management

- Increased residue cover plays a significant role in moderating soil temperature
- Adequate residue cover reduces soil evaporation and conserves soil moisture
- High residue cover in a cold environment and poorly drained soils may reduce early seed germination, especially with NT

Equipment considerations for continuous corn

Mark Hanna, Extension Agricultural Engineer, Ag and Biosystems Engineering, Iowa State University.

General residue issues

- High yield levels, stronger stalks
- Tire wear
- Fresh stalks during fall operation

Combine spreader and chopper

- Vane adjustments
- Knife position, sharpness

Stalk chopper

- Clearance issues for tillage equipment
- Extra implement operation
- Corn head attachment

Tillage implements

- Residue clearance
- Coulters for cutting and sizing
- Fertilizer incorporation
- Why till?
- CSP, HEL, energy use

Planter

- Row cleaners/coulter
- Seed opener
- Closing system
- Leveling frame